Test results of the low-energy neutron detector for LAMPS at RAON

유재희*, 박재범, 김범곤, 이경세, 홍병식
Korea University
Nuclear Physics Laboratory

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motivation

1. Large Acceptance Multi-Purpose Spectrometer(LAMPS) to maximize the use of nuclear physics researches for neutron-rich nuclei

- Main purpose for **Symmetry-Energy research**
- Understanding astronomical phenomena in neutron stars, black holes, and super novae by the EOS of nuclear matter at high density.

2. The neutron is particularly important to study the nuclear symmetry energy in the ratios of mirror nuclei and the flow parameters.

- Large acceptance of neutron detectors via **TOF measurement**

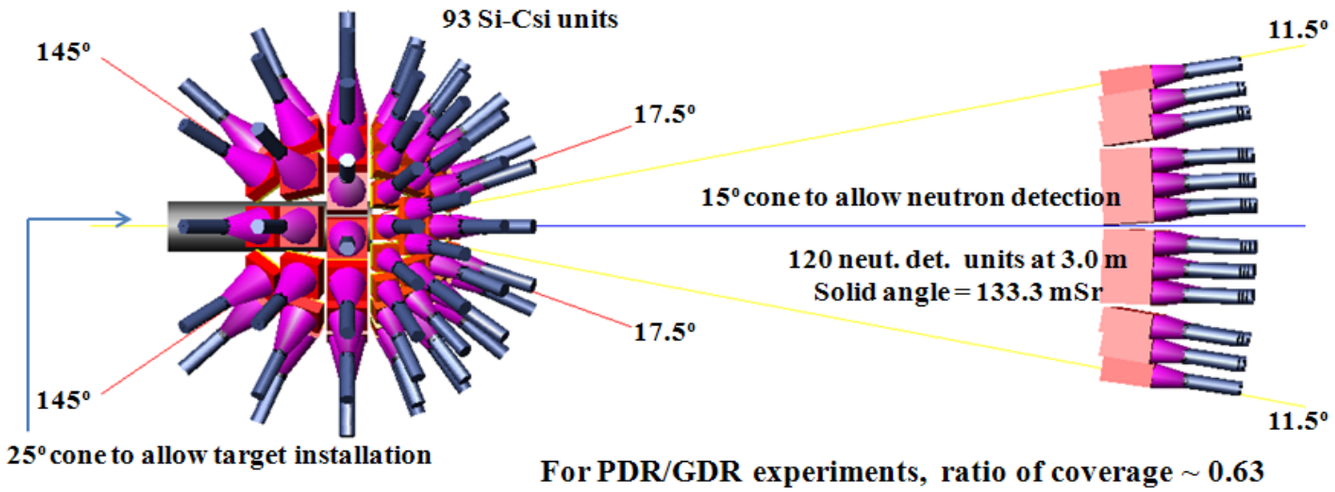
Neutron detectors for low-energy experiment

Basic structure of unit pixel detector: 3 x 3 detector modules

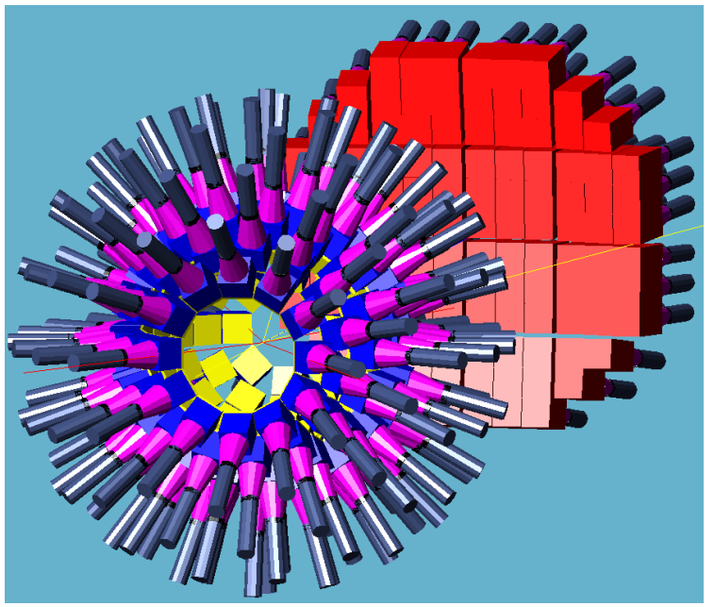
Single detectors: 10 x 10 x 20-cm^3 plastic scintillator blocks

This experiment : 7 detector modules

Single detectors: 10 x 10 x 20-cm^3 plastic scintillator blocks



For PDR/GDR experiments, ratio of coverage ~ 0.63
Total # of units = 93 units



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TOF with 252Cf

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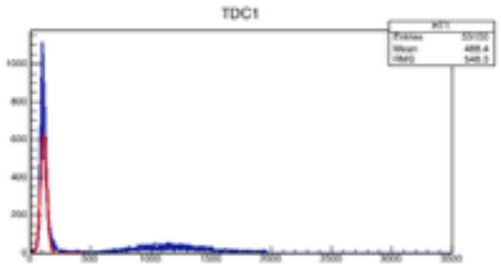
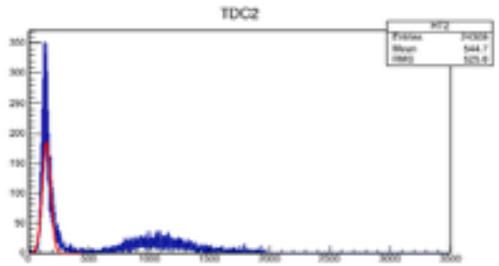
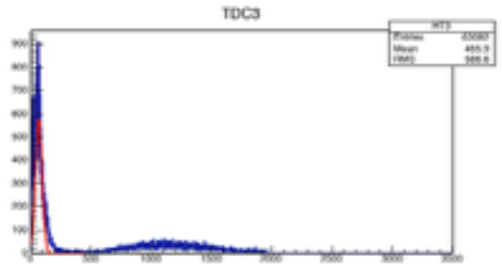
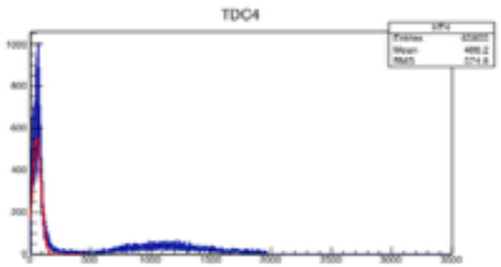
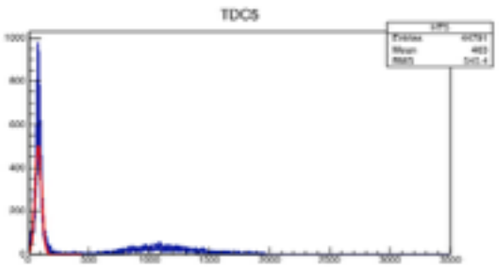
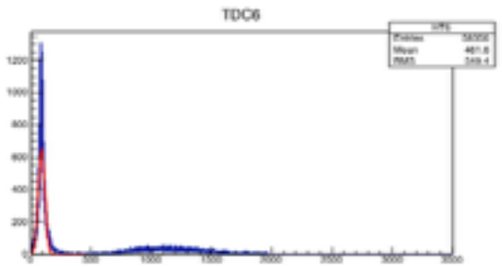


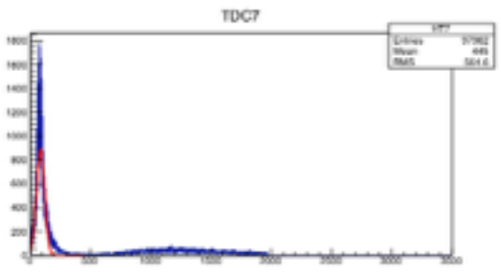






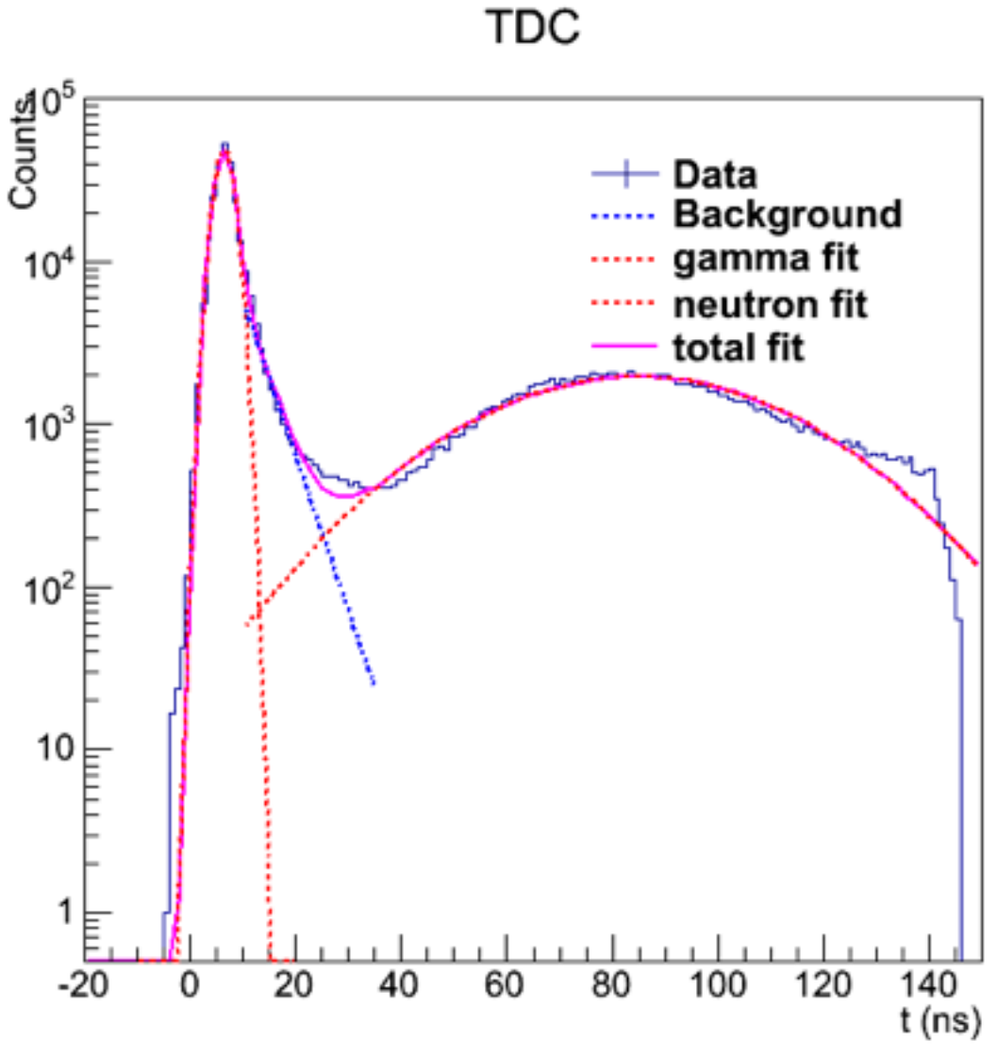


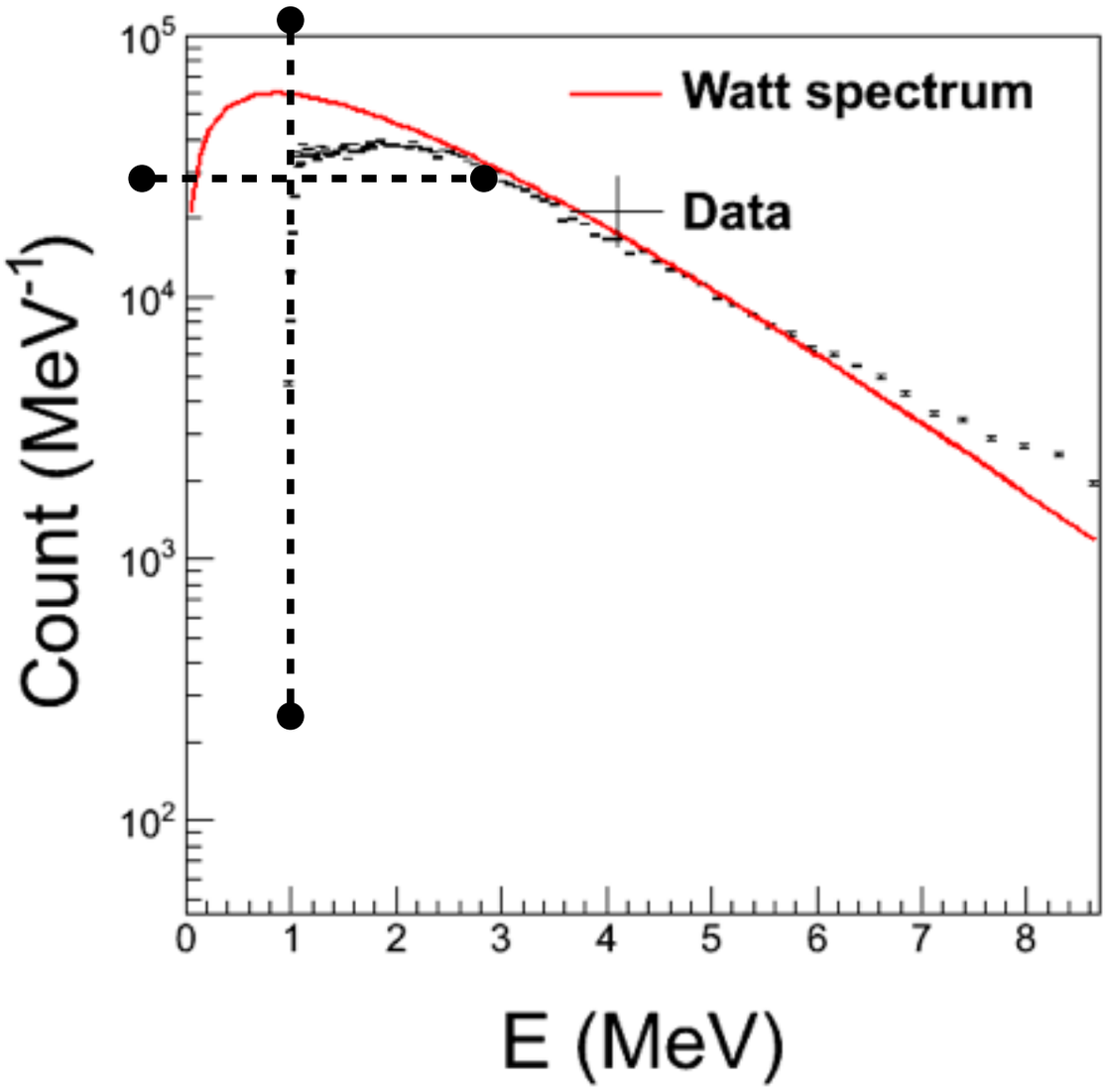




- Gamma and neutron are emit by californium 252
- Gamma will be used as reference of time
- TOF method is used to calculate energy of neutron

Time distribution & Watt spectrum



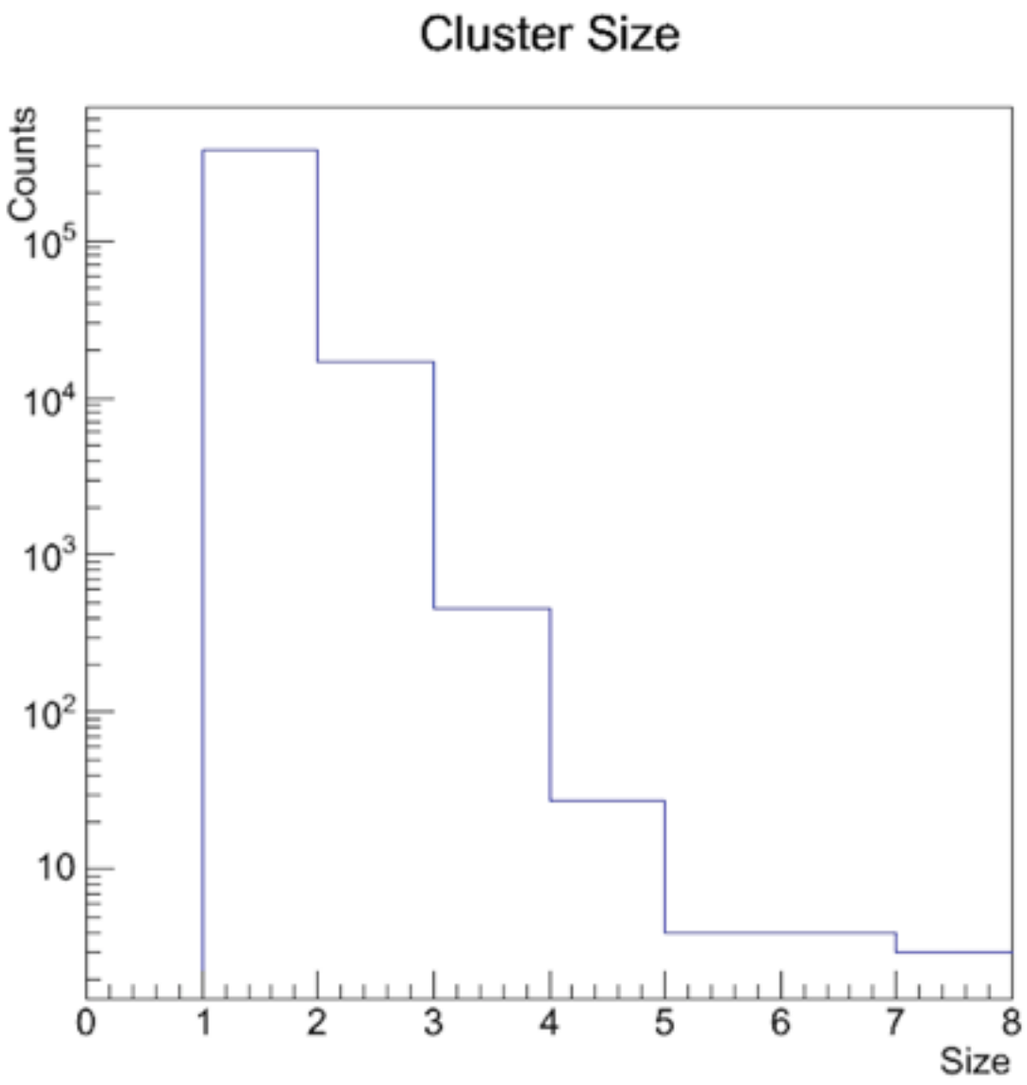


Neutron energy with 50% efficiency **~ 1.0 MeV**

7 module block detector can detect over than 1MeV/c^2 neutron

Cluster Size

	Number	ratio with cs=1)
cs=1	3,718,00	
cs=2	17,010	0.04575
cs=3	452	0.001216
cs=4	27	0.00007262



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Hit Distribution

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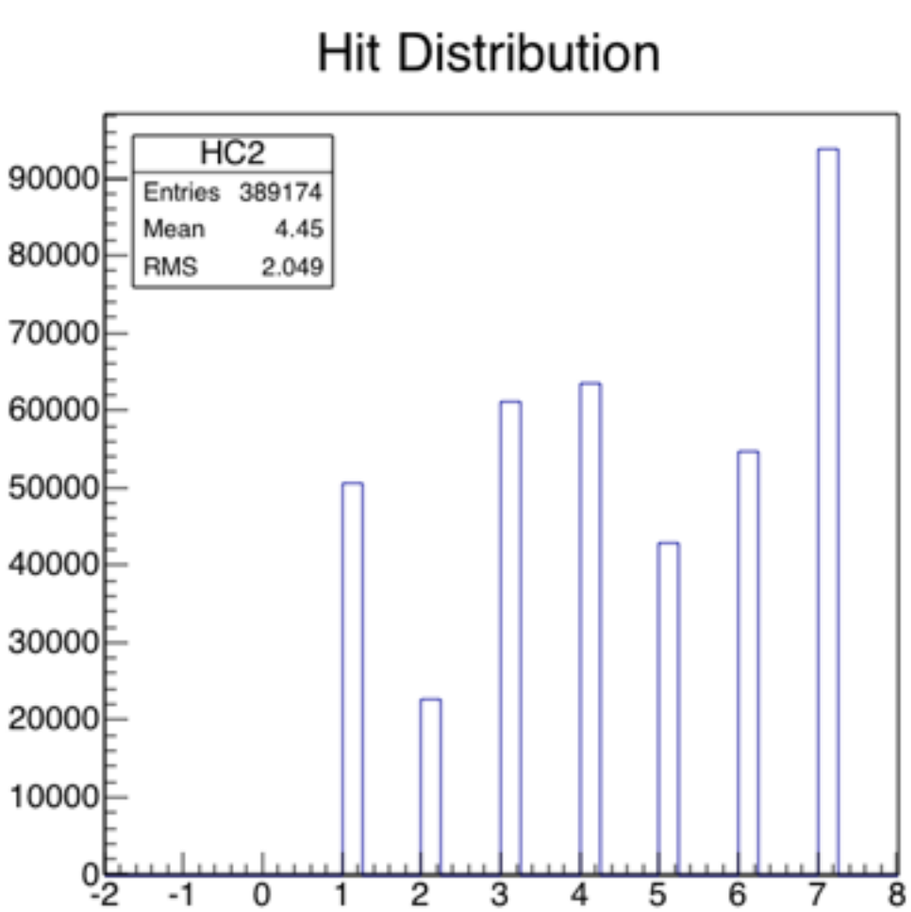
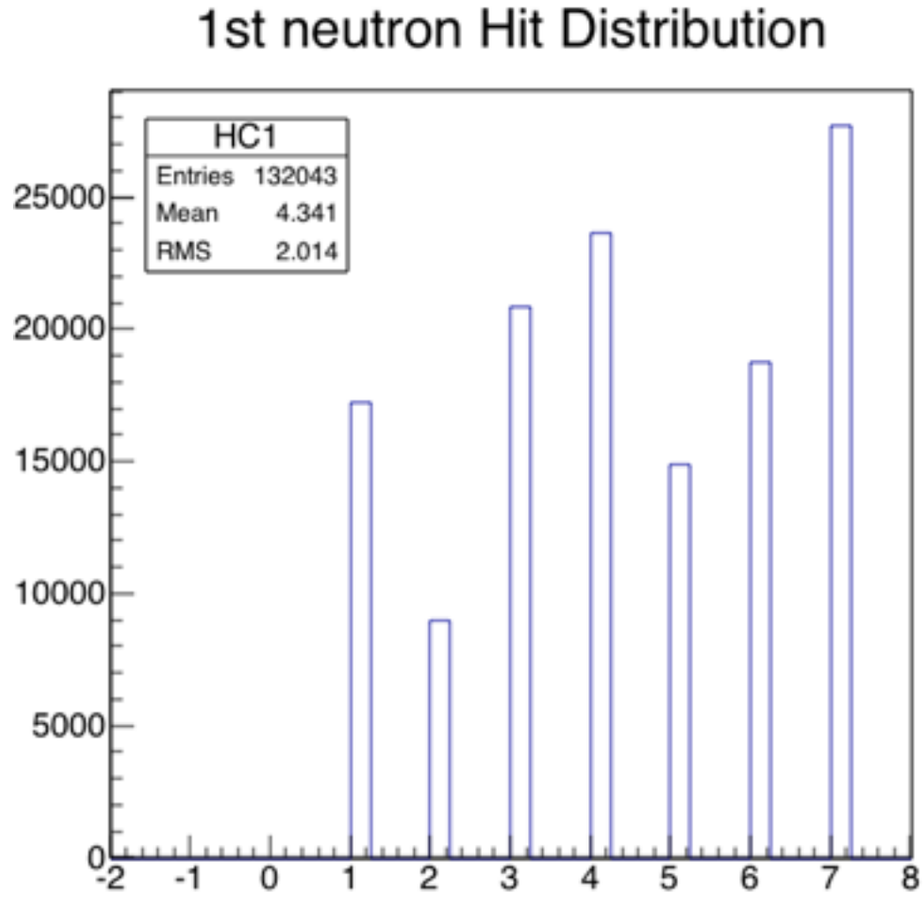


gamma + neutron



neutron

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2nd Hit Distribution

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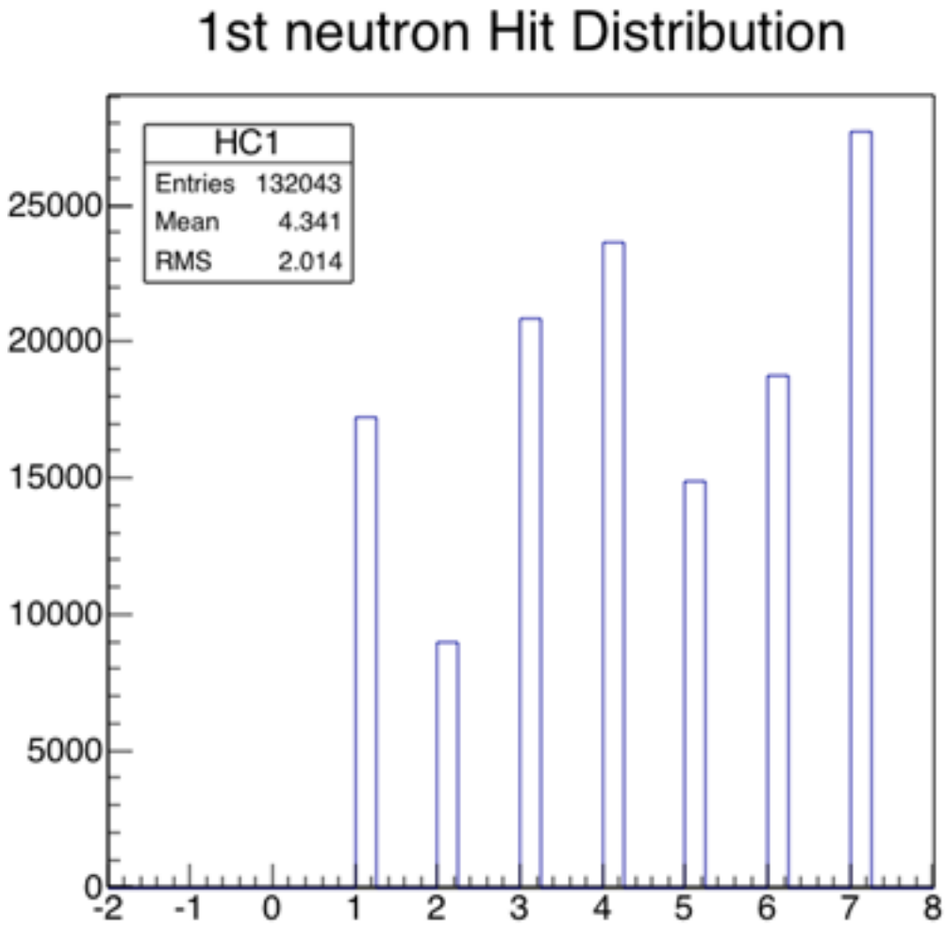
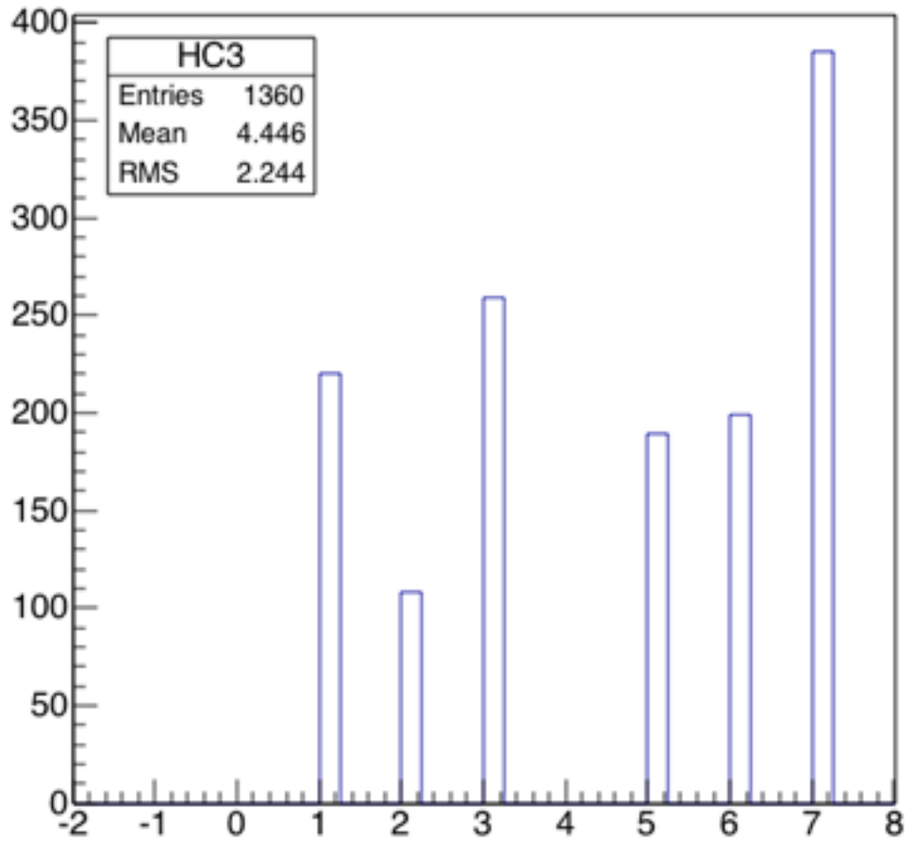


1st hit neutron



2nd hit neutron
(in case of central 1st hit)

Normalization

	1st hit	2nd hit	ratio(2nd/1st)	normalization(ratio/ratio mean value)
D1	50550	220	43.52	1.029
D2	22770	107	46.99	1.111
D3	61000			
D4	63500	257	42.13	0.9960
D5	42800	188	43.93	1.039
D6	54750	198	36.16	0.8548
D7	93700	385	41.07	0.9695

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Summary

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1. block-type neutron detectors for low-energy experiments

- Minimum neutron energy confirmed with **ε > 50% was 1.0 MeV**
- Ratio between 1st hit and 2nd hit is generally 4.5%.
- Second Hit acceptance is more than 85%.

2. Plans for LAMPS low neutron detector

- LAMPS low neutron detector simulation using GEANT4.